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Influence of violent video gaming on determinants of the acquired capability for suicide

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ABSTRACT

The interpersonal theory of suicidal behavior proposes that fearlessness of death and physical pain insensitivity is a necessary requisite for self-inflicted lethal self-harm. Repeated experiences with painful and provocative events are supposed to cause an incremental increase in acquired capability. The present study examined whether playing a first-person shooter-game in contrast to a first-person racing game increases pain tolerance, a dimension of the acquired capability construct, and risk-taking behavior, a risk factor for developing acquired capability. $N=81$ male participants were randomly assigned to either play an action-shooter or a racing game before engaging in a game on risk-taking behavior and performing a cold pressor task (CPT). Participants exhibited higher pain tolerance after playing an action shooter game than after playing a racing game. Furthermore, playing an action shooter was generally associated with heightened risk-taking behavior. Group-differences were not attributable to the effects of the different types of games on self-reported mood and arousal. Overall these results indicate that action-shooter gaming alters pain tolerance and risk-taking behavior. Therefore, it may well be that long-term consumption of violent video games increases a person's capability to enact lethal self-harm.

1. Introduction

Suicide is a significant public health concern, with more than one million people worldwide dying from suicide every year (World Health Organization, 2013). Suicide is among the three leading causes of death among those aged 15–24 years and is the tenth leading cause of death for all ages in the United States (American Association of Suicidology, 2013). Males complete suicide at a rate 3–7 times that of females (Nock et al., 2008). In about 3.8% of the cases, suicidal persons impact other individuals (Large et al., 2009), sometimes in the form of spree killings, usually ending in the suicide of the perpetrator (Scheithauer and Bondü, 2011). A regularly discussed hypothesis concerning the possible causes of spree killings and school shootings is an increased engagement of the contraveners in violent video games, in which virtual enemies must be killed by different means (Anderson, 2004). Anderson (2004) assumes that action-shooter games reinforce killing and aggressive behaviors, which in turn might lead to a transfer of these behaviors into the real world. Yet, it is unclear if action-shooter games can be considered a risk factor for attempting or completing suicide and if so, which mechanisms link the frequent use of action-shooter games to increased suicide risk.

According to the *Interpersonal Psychological Theory of Suicidal Behaviour* (Joiner, 2005) three proximal, causal and interactive risk factors must be present in order for someone to both desire and be capable of suicide: The most dangerous form of suicidal desire is said to be caused by the simultaneous presence of *thwarted belonginess* – the experience that one is alienated from others, not an integral part of a valued group – and *perceived burdensomeness* – the view that one's existence burdens family, friends, and/or society. Yet, Joiner (2005) claims that desire to die by suicide is not sufficient to lead to lethal suicidal behavior – rather individuals have to have developed a fearlessness of pain, injury and death to be capable to act on the desire for suicide. According to this theory, the so-called *acquired capability for suicide* arises from repeated exposure to painful and/or fear inducing experiences. Van Orden et al. (2010) distinguish two dimensions of acquired capability: *lowered fear of death* and *increased tolerance for pain*.

Joiner (2005) proposes that the most direct route to acquiring the capability for suicide is by engaging in suicidal behavior, either through suicide attempts, or practicing and preparing for suicidal behavior. In line with this assumption, past suicide attempts are

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one of the strongest predictors of future suicide attempts – even after controlling for hopelessness and various psychopathological syndromes (e.g. Joiner et al., 2005). However, Joiner (2005) points to the fact that one can also become less fearful of pain, injury and death by experiences other than suicide attempts, e.g. childhood abuse, combat exposure, painful and provocative events like physical fights, promiscuous sex, playing contact sports etc. All of these experiences are supposed to increase the risk for lethal suicidal behavior because they are physically painful and/or sufficiently frightening to engage habituation and opponent processes (Solomon, 1980).

Evidence for the credibility of the suicidal theory is accruing, with a growing number of studies demonstrating profound associations between the theory's key variables and different markers of suicidality: Thus it has been shown that individuals with a history of suicidal behavior exhibited higher levels of the acquired capability than individuals with no history of suicidal behavior and that acquired capability is predictive of suicidal behavior (Van Orden et al., 2008; Anestis and Joiner, 2011). In general, men exhibit higher levels of acquired capability than women and soldier-samples exhibit higher levels than student-samples (Bryan et al., 2010; Witte et al., 2012). In accordance with the theoretical assumptions, higher levels of painful and provocative experiences significantly predicted higher levels of acquired capability and combat experiences characterized by violence and high levels of injury and death are strongly associated with the acquired capability (Van Orden et al., 2008; Bryan and Cukrowicz, 2011). With regard to the pain-tolerance dimension of acquired capability, several studies found that individuals with recent suicidal behavior demonstrate elevated physical pain tolerance (as measured by electric shock and thermal pain), compared with non-suicidal psychiatric patients and individuals in the community (Orbach et al., 1996a; Orbach et al., 1997) and compared with individuals admitted to the emergency room due to accident injuries (Orbach et al., 1996b). The latter finding indicates that elevated pain tolerance is likely specific to suicidal behavior rather than physical injury (cf. Van Orden et al., 2010). Bender et al. (2011) found self-reported experiences of painful and provocative events as well as acquired capability to be significantly associated with pain tolerance in a pressure algometer task and Franklin et al. (2011) could show that pain tolerance – assessed with a cold pressor task (CPT) – partially mediated the association between self-reported experiences of painful and provocative events and acquired capability. Finally, it has been found, that experiences with painful and provocative events mediated the relationship between impulsivity and suicidality: This means that impulsive individuals tend to have higher levels of acquired capability for suicidal behavior because they have experienced more painful and provocative events in their lives (Bender et al., 2011).

To date, no study has examined the role of violent video games in the development of acquired capability for suicide. There are studies showing that playing violent video games is associated with an increase in aggressive thoughts, feelings and behaviors, leading to desensitization to violence and also to decreases in pro-social behaviors and empathy (Anderson and Warburton, 2012). For example, Carnagey et al. (2007) found that participants who had previously played a violent video game for 20 min exhibited reduced physiological arousal while watching films of real violence thereafter, demonstrating a physiological desensitization to violence. Furthermore, video games that glorify risk-taking behavior have been shown to be associated with more risk-taking behaviors, cognitions, attitudes and risk-positive emotions (Fischer et al., 2011). Yet, it is unknown, whether dimensions and indicators of the acquired capability of suicide are also influenced by playing first-person shooter games. The current study addresses this issue. Thus, the study examined whether playing action-shooter games in contrast to engaging in an action-packed non-violent racing game was associated with elevated levels of pain tolerance – as one of the key dimensions of acquired capability – in a sample of healthy young males. Additionally, – building on the notion that impulsivity or risk taking behavior contribute to the acquisition of capability for suicide – we examined whether playing an action-shooter game led to an increase of risk-taking behavior and whether this increase was greater than the change after playing a racing game.

2. Method

2.1. Participants

The study included 81 men, aged from 18 to 39 ($M=26.2$, S.D.$=5.2$ years). All participants were Caucasian. To take part in the study, participants had to be between 18 and 50 years old. Due to their influence on pain tolerance and risk-taking behavior, exclusion criteria were female gender, diagnosis of a psychiatric disorder, substance dependency or abuse, cardiovascular diseases and intake of psychoactive drugs, beta-blockers, analgesics as well as current suicidal ideation. In addition, participants were required not to have consumed alcoholic beverages on the day of the experiment.

Ten men (12%) were married, 24 men (30%) lived in a stable relationship and 47 of them (58%) were singles. Three participants (4%) reported having completed 10 years of education, 42 men (52%) had finished their A-levels, five participants (6%) had received their vocational baccalaureate diploma, 21 participants (26%) had graduated from a university and 10 participants (12%) had a professional qualification. Seventy-three subjects (90%) had at least once in their lifetime played *video games* for a mean length of 12 months. Twenty-nine participants (36%) had never played an action-shooter game. At present, 31 individuals (38 %) reported playing action-shooter games at least once a week. Fifty participants (62 %) denied playing action-shooters at the present time. None of the participants reported having ever attempted suicide.

All participants provided full, informed, and written consent for research participation. Study participation was voluntary and there was no monetary compensation for study participation. The study was approved by the Ethic Committee of the Faculty of Psychology at the Ruhr-Universität Bochum.

2.2. Procedure

Potential participants were approached face-to-face or via posted flyers recruiting healthy male volunteers for a study on gaming, pain and impulsivity. Inclusion and exclusion criteria were displayed on the advertisements. Persons who responded to the advertisement were given a code to access an internet-based questionnaire and screening tool. Participants were questioned about sociodemographic data, medication intake, substance use, lifetime suicide attempts, known physical and psychiatric disorders and acquired capability for suicide. Using the Suicide Subscale of the Depression Severity Index (DSISS; Joiner et al., 2002) and the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977) it was ascertained that none of the participants had suicidal intentions (DSISS-score ≥ 1) or suffered from acute depression (CES-D-score ≥ 23). None of the potential participants had to be excluded from study participation.

After study intake participants were randomly assigned to four different conditions: There were two experimental groups (EG1 and EG2) and two control conditions (CG1 and CG2). Participants in all conditions started the experiment by playing a video game – either an action shooter game (EG) or a non-violent sports game (CG). Afterwards, half of the participants in either group received an experimental pain induction before engaging in a game of risk-taking behavior (EG1 and CG1). Half of the participants in either group started the game of risk-taking behavior before receiving the pain induction (EG2 and CG2). Participants' current mood was assessed directly before and after playing the video games. The investigation was conducted by two experimenters located in two separate laboratories: In laboratory 1, participants were randomized and conducted the video game. In laboratory 2, participants engaged in the pain induction and the risk taking game with the experimenter in laboratory 2 being blind to the experimental condition. Given that experimenter gender has been shown to impact experimentally assessed pain tolerance (Kállai et al., 2004), experimenter gender was held constant across the entire investigation – with a male researcher in lab 1 and a female researcher in lab 2. All participants were monitored individually.

2.3. Experimental tasks

2.3.1. Video games

Subjects in both experimental groups played the action-shooter game "*Counter Strike: Source*: *level de_chateau*". In this game participants act as member of a terrorist group and are instructed to kill soldiers of an anti-terror squad without getting killed themselves. Subjects in both control groups played a car race

simulation game called "*Need for Speed: Shift*". In this game participants were asked to complete as many rounds of the circuit Donnington Grand Prix as possible without leaving the track or causing accidents. According to a nationwide study, the games belong to the top 10 games for boys in Germany, with 27% having played "Counterstrike" and 11.4% being familiar with "Need for speed" (Rehbein et al., 2010). The two games differ in content (violent vs. nonviolent). Yet, perspective, information given on the screen, number of opponents (eight) and game duration (20 min) were held constant across conditions. Both games were presented with Windows 7 Enterprise 64 bit on a computer with a 19-in. display (resolution: 1280 × 1024). The distance of subject–display was 50–70 cm while sitting.

2.3.2. Cold pressor task (CPT)

Pain tolerance was assessed with a cold pressor task – one of the most widely used forms of experimental pain induction in psychological studies (e.g. Franklin et al., 2011). To perform the CPT, participants immersed their left forearm (if left-handed the right forearm) including the elbow into a cooler container (50 cm × 40 cm × 35 cm) filled with a mixture of crushed ice and water. The temperature of the water was 2 °C (as indexed by a thermometer). Pain tolerance was determined as the time elapsed from arm submersion until participants pulled their arm out of the water, indicating that they could no longer withstand the pain. Elapsed time was measured with a stopwatch. Participants were allowed to pull their arm out of the water whenever they desired, and were allowed to keep their arm in the water for a maximum of 5 min.

2.3.3. Game of dice task – modified version (GDTmod; Brand, 2008)

The GDTmod is a virtual dice game. In 18 trials subjects have to guess which number or which combination of numbers presented on the screen includes the number that will be thrown next. Participants can choose from different fixed alternatives (one single number or a combination of two, three or four numbers) differently associated to specified gains or losses (1000€–100€) dependent on their winning probabilities (1:6–4:6). Before starting participants are told that the goal of the game is to win as much money as possible and lose as little as possible. Feedback about the consequences of each possible decision is provided in the game instructions. There is no feedback while playing, so that participants' future decisions are not influenced by a feedback on prior rounds. The difference between non-risky and risky decisions generates a *Nettoscore* (range: −18 to 18), with lower scores indicating a higher level of risk-taking behavior. Lower GDT performance has been shown to be significantly correlated to impulsivity in general (Brand et al., 2007; Svaldi et al., 2012), as well as to different facets of impulsivity, such as sensation seeking and negative urgency (Bayard et al., 2011). Furthermore, risky decision making in the GDT has been found in excessive Internet gamers (Pawilowski and Brand, 2011) and is associated with diverse psychiatric disorders, such as borderline personality disorder (Svaldi et al., 2012).

2.4. Questionnaires

2.4.1. Acquired Capability for Suicide Scale (ACSS; Joiner et al., 2009)

The ACSS is a 20-item self-report questionnaire that assesses the respondent's fearlessness about lethal self-injury ("I am not at all afraid to die"). Individuals are asked to rate each item on a five-point Likert scale ranging from 1 (*not at all like me*) to 4 (*very much like me*). Internal consistency (Cronbach's α) was adequate in a previous study, $\alpha=0.83$ (Bender et al., 2011). Accordingly, internal consistency was good in the current study, Cronbach's $\alpha=0.84$.

2.4.2. Mood Survey Scale (MSS; Befindlichkeitsfragebogen; Abele Brehm and Brehm, 1986)

The MSS is comprised of 20 emotional adjectives with a 5-point Likert scale indicating the experience of each emotion at the present moment (e.g., active, sad, joyful). The 20 items are classified into the four subscales of activation, lack of energy, low mood and positive mood with each subscale incorporating five items. The internal consistency (Cronbach's α) lies at 0.73–0.88 (Abele Brehm and Brehm, 1986). In the current sample internal consistency was Cronbach's $\alpha \geq 0.76$.

2.5. Data analysis

SPSS 19.0 for Windows was used for the statistical analysis. Differences between the four groups concerning demographic and clinical characteristics were examined using a series of one-way analysis of variance (ANOVA) and χ^2, respectively. Associations between study variables were assessed with zero-order correlations. To test whether the different types of video games affected participants' mood in a differential manner, a series of 2 (time) × 4 (group) repeated measures ANOVA was conducted on the different subscales of the MSS. Finally, two ANOVAs were conducted to examine group differences in pain tolerance and risk-taking behavior. Post-hoc comparisons were conducted with *t*-tests for independent samples. In addition, between-group effect sizes (Cohens *d*) were calculated. Due to software problems, two participants had to be excluded from the analysis on group differences in risk-taking behavior.

3. Results

3.1. Participant characteristics

Participants in the four groups did not significantly differ in age [$F(3, 77)=0.2$, $p=0.896$], marital status [$\chi^2=11.83$, d.f.=9, $p=0.223$], education level [$\chi^2=9.91$, d.f.=12, $p=0.623$], gaming experience [$\chi^2=17.22$, d.f.=24, $p=0.829$] and self-reported levels of acquired capability for suicide, [$F(3, 77)=0.36$, $p=0.786$]. Across groups, ACSS-scores were significantly correlated with pain tolerance scores ($r=0.27$, $p=0.015$). Risk-taking behavior assessed via the Game of dice task was not correlated with ACSS-scores ($r=0.05$, $p=0.680$). Pain tolerance and risk-taking behavior were negatively correlated ($r=-0.34$, $p=0.002$) – indicating that higher pain tolerance was associated with more risk-taking behavior.

3.2. Mood check

Mood ratings were obtained before participants started to play a video game (*t*1) and immediately after they finished playing either the action-shooter or the sports game (*t*2). Data were analyzed using a series of 2 (*t*1, *t*2) × 4 (EG1, EG2, CG1, CG2) repeated measures ANOVAS on the different subscales of the Mood Survey Scale. The analysis of the mood ratings yielded a main effect of time for the activation subscale, $F(1, 77)=14.09$, $p=0.000$, the loss of energy subscale, $F(1, 77)=8.04$, $p=0.006$, and the positive mood subscale, $F(1, 77)=3.98$, $p=0.050$, indicating that participants felt more animated and less positive after playing the different types of video games (see Table 1). No main effect of time was found for the depression subscale of the MSS, $F(1, 77)=0.89$, $p=0.349$. Furthermore, neither a main effect of group [activation: $F(3, 77)=0.92$, $p=0.434$; energy: $F(3, 77)=0.17$, $p=0.914$; positive mood: $F(3, 77)=0.36$, $p=0.780$; depressed mood: $F(3, 77)=1.38$, $p=0.254$], nor a time x group interaction [activation: $F(3, 77)=0.13$, $p=0.940$; energy: $F(3, 77)=0.44$, $p=0.725$; positive mood: $F(3, 77)=1.20$, $p=0.315$; depressed mood: $F(3, 77)=0.88$, $p=0.349$], was found for any of the MSS-subscales. Thus, the different types of video games did not exert unique influence on participants' mood and activation.

3.3. Game effects on pain tolerance

A one-way ANOVA demonstrated statistically significant differences between the four groups considering pain tolerance, $F(3, 77)=21.39$, $p=0.000$. Post-hoc *t*-tests for independent groups revealed statistically significant group differences between EG1 and CG1, $t(39)=4.67$, $p=0.000$, $d=1.22$, EG1 and CG2, $t(39)=4.21$, $p=0.000$, $d=1.15$, as well as EG2 and CG1, $t(39)=7.89$, $p=0.000$, $d=1.51$, and EG2 and CG2, $t(38)=6.88$, $p=0.000$, $d=1.44$. As can be seen in Table 2, participants in the experimental groups exhibited higher pain tolerance than participants in the control

Table 1
Mood ratings assessed with the Mood Survey Scale before (pre) and after (post) playing the video games.

Mood	Pre	Post
	M (S.D.)	*M* (S.D.)
Activity	16.54 (3.53)	18.16 (2.88)
Lack of energy	10.14 (4.42)	8.88 (3.34)
Low mood	9.25 (2.02)	9.43 (2.24)
Positive mood	18.44 (3.06)	17.72 (3.53)

Table 2
Means and standard deviations of pain tolerance in seconds and the nettoscores of the games of dice task.

	EG1		EG2		CG1		CG2	
	n	*M* (S.D.)	*n*	*M* (S.D.)	*n*	*M* (S.D.)	*n*	*M* (S.D.)
Pain tolerance (CPT)	21	271.43 (68.29)	20	295.00 (15.73)	20	172.00 (67.87)	19	177.50 (74.68)
Nettoscores[a] (GDT)	19	3.79 (9.91)	20	0.80 (11.38)	20	12.40 (6.54)	19	7.89 (10.60)

Note: CPT=cold pressor task; GDT=game of dice task.

[a] Lower nettoscores indicating higher risk-taking behavior.

groups. Neither the two experimental conditions nor the two control conditions differed in pain tolerance [EG1 vs. EG2, $t(39)=-1.50$, *ns*, $d=0.29$; CG1 vs. CG2, $t(38)=-0.24$, *ns*, $d=0.07$] – indicating that the results are not biased due to sequential effects.

3.4. Game effects on risk-taking behavior

A one-way ANOVA revealed significant differences between the four groups concerning risk-taking behavior, $F(3, 77)=5.30$, $p=0.002$. Post-hoc *t*-tests for independent groups revealed statistically significant group differences between EG1 and CG1, $t(37)=-3.22$, $p=0.003$, $d=1.38$, as well as EG2 and CG1, $t(38)=-3.95$, $p=0.000$, $d=1.86$, and EG2 and CG2. $t(37)=-2.01$, $p=0.050$, $d=1.13$, – with the participants in the experimental groups showing more risk-taking behavior than participants in the control groups (see Table 2). Yet, no statistically significant difference was found between EG1 and CG2, $t(36)=-1.23$, *ns*, $d=0.66$. Neither the two experimental conditions nor the two control conditions differed in risk-taking behavior [EG1 vs. EG2, $t(37)=-0.87$, *ns*, $d=0.48$; CG1 vs. CG2, $t(37)=1.61$, *ns*, $d=0.72$].

4. Discussion

The interpersonal theory of suicidal behavior proposes that fearlessness of death and physical pain insensitivity is a necessary requisite for self-inflicted lethal self-harm: In order to die by suicide one must face the fearsome prospect of death as well as the physical discomfort necessary to withstand the act of lethal self-injury. According to Joiner (2005) people can acquire such a capability for suicide by repeated experiences with painful and provocative events. The present study examined whether playing action-shooter games may contribute to an increase in acquired capability. In line with the predictions, action-shooter gaming was associated with heightened levels of pain tolerance and risk-taking behavior compared to playing a non-violent race simulation game.

Participants in the action-shooter groups tolerated the pain induced by the cold pressor test significantly longer than subjects in the racing game groups. This is especially interesting since the different video games played did not exert a unique influence on mood and activation levels – participants felt more animated and a little less positive after playing the different types of video games, yet, changes took place equally in all groups. Therefore, differences in pain tolerance after gaming are not accounted for by differences in mood or activation levels. This finding supports the notion, that action-shooting might be understood as a kind of painful and provocative experience in the sense of Joiner (2005). Although speculative, it is therefore possible that engaging in violent video games may set psychological and biological processes in play, which might place a person on a pathway that increases willingness or ability to tolerate pain. At this time it is unclear whether the effect of violent video gaming on pain tolerance is only spurious or whether frequent playing of action-shooter-games in fact adds to an incremental and stable increase in acquired capability. Furthermore, it is unclear whether playing an action-shooter game does not only alter the pain-tolerance dimension of the acquired capability construct but also affects the fear of death and dying dimension. The latter finding would be especially interesting since pain tolerance is a rather general variable whereas fear of death is a relatively suicide specific variable. Significant correlations between pain tolerance and self-reported acquired capability in this study as well as in other studies (Bender et al, 2011; Franklin et al., 2011) point to a close relationship between the two dimensions. Nevertheless, future studies should directly assess the influence of violent video gaming on fear of death and dying. Furthermore, the mechanisms by which playing an action-shooter game influences pain tolerance should be addressed in future studies. According to the interpersonal theory of suicidal behavior, repeated exposure to painful and provocative stimuli will result in a decrement of the original response towards fear-inducing stimuli (e.g. fear and pain) and in an increase in the response of the opposite valence (e.g. relief and analgesia; Joiner et al., 2012). In this sense, exposure to self-executed virtual violence may not only foster habituation to real-life pain and fear (cf. Carnagey et al., 2007), but may also contribute to an increase in feelings of boldness. It is well established that feelings of competence affect the subjective experience of pain, with heightened self-efficacy being associated with heightened pain tolerance (e.g. Williams and Kinney, 1991). Following this line of research, it may well be that the participants felt more competent in dealing with pain after identifying with an undaunted heroic aggressor. It may also be that playing an action-shooter game alters the cognitive reference point for pain perceptions: After dealing with murder and agony in a violent video game the pain induced by cold water may seem rather mundane and tolerable.

As predicted, the levels of risk-taking behavior were generally higher in the experimental groups than in the control groups: Participants in EG2 showed significantly more risk-taking behavior than participants in both control groups and participants in EG1 showed more risk taking behavior than participants in CG1. Yet, participants in EG1 and CG2 did not differ in risk-taking behavior. Though both experimental groups as well as both control groups did not significantly differ in risk-taking, this result points to the possibility that risk-taking behavior was not only influenced by the different kinds of video games but also by sequential effects of the experimental set up. Descriptively, risk-taking behavior was higher whenever the game of dice task preceded the cold pressor task. It seems that the experience of pain dampened the risk-taking behavior. Nonetheless, results generally showed that participants behaved more risky after playing a violent video game than after playing a fast race game (cf. Fischer et al., 2011). Therefore, our study produced some evidence to the effect that playing an action-shooter game does not only contribute to the pain-tolerance dimension of acquired capability, but also to a less direct route in acquiring capability, namely risk-taking behavior – a facet of impulsivity.

According to Joiner (2005) the relationship between impulsivity and suicide is rather indirect: People who are impulsive often do painful and provocative things, and over time they habituate to the pain of these events giving them the acquired capability to kill themselves (should they ever desire it). In light of this, the significant correlation between risk-taking behavior and pain tolerance could be interpreted as a link between risky behavior and acquired capability. Yet, risk-taking behavior in the game of dice task was not correlated with self-reported acquired capability in the

current study. Similar results have been reported by Bender et al. (2011), who neither found a significant correlation between self-reported impulsivity and acquired capability ($r=0.02$, *ns*). In their study, impulsivity was associated with experiences of painful and provocative events and only experiences with the latter were associated with acquired capability. Taken together, future studies should continue to address possible ways by which risk-taking behavior may contribute to acquired capability and suicidal behavior. Furthermore, the mechanisms by which playing violent video games alter risk-taking behavior are understudied. Concerning street racing games it is well documented that an increased accessibility of risk-positive cognitions, emotions and behavioral scripts mediates effects on risk-taking inclinations and behaviors (Fischer et al., 2011). For example, Fischer et al. (2009) found that the increased risk-taking of racing game players (vs. non-racing game players) is partly mediated by participants' increased self-perception as reckless drivers. It may well be that a similar process underlies the association between first-person shooter games and risk-taking behavior shown by our study. Therefore, playing an action-shooter game may activate perceptions of being a reckless "daredevil" – even more so, than engaging in a racing game.

It is of great importance that future studies on the mechanisms underlying the influence of violent video games on perception and behavior should not only clarify the role of explicit cognitions amenable to introspection, but also examine the role of implicit cognitions which possibly are instigated rather automatically by cues of violent video games (cf. Yen et al., 2011). In this context, brain imaging studies could help to determine whether differential patterns of cerebral activation are instigated by different types of games. The present findings may also have practical implications: Joiner (2005) described the acquired capability for suicide as a static process increasing incrementally as painful and provocative events are experienced. Therefore, acquired capability is said to be relatively difficult to address in treatment since a therapist is not able to modify a patient's history. Yet, Smith and Cukrowicz (2010) suppose that there is also a degree of moment-to-moment variability in capability for suicide. According to these authors, different actions or experiences, such as substance intoxication or dissociative states, should cause a short-term boost of capability. It may well be that excessive play of violent video games while feeling suicidal also contributes to such a short-term bolstering of capability. In this sense, restricting access to violent video games may be beneficial in times of crisis. Furthermore, in order to inhibit over-time strengthening of acquired capability restricting time spent with violent video games seems worth considering – at least in at-risk populations (cf. De Wall et al., 2011).

There are several limitations that should be considered when interpreting the results of this study. First, acquired capability, pain tolerance and risk-taking behavior were not examined in relation to suicidal behavior due to zero-levels of suicidality in this non-clinical sample. Although the results support the proposed link between action-shooter games and the capability for suicide, it is therefore impossible to explicitly link capability to suicidal behaviors in this study. Furthermore, it is not possible to determine the relative influence of action-shooter gaming compared to other types of painful and provocative events in acquiring capability and executing suicidal thoughts. In general, caution is warranted when extrapolating from behavior of healthy subjects to clinical psychiatric patients. Second, the male-only sample makes it impossible to draw conclusions about females playing action-shooter games. However, given that death by suicide rate and playing violent video games is skewed heavily toward men, using a male sample seems acceptable and could nonetheless provide critical information. Third, a water circulation device to guarantee a precise constant temperature was not used during the cold pressor test. Though it is rather unlikely that participants in the control groups benefited from greater heat build-ups around their arm than participants in the experimental groups, comparability with other studies on pain tolerance is rather limited. Moreover, it would have been beneficial to measure differences in hand and arm temperature after playing the different games and before conducting the cold-pressor test. It is possible that participants in the action-shooter condition were physically more active while playing than those in the driving condition. In this case, blood flow in the arm would have increased and heated up the water around the arm in the violent condition, enabling the participants to last longer in ice water. Yet, if this would have been the case, one would expect the participants starting with the cold-pressor task before conducting the game of dice task (EG1) to show greater pain tolerance than the participants starting with the game of dice task before conducting the cold-pressor task (EG2), since the latter would have had more time to "cool down" after gaming. However, the two conditions did not differ in pain tolerance. Nonetheless, it would be beneficial to use a water circulation device and control for arm temperature in future studies. Fourth, different experimental assessments of pain (e.g. heat pain, ischemic pain and pressure pain) are generally highly correlated (Klatzkin et al., 2010), nonetheless future studies should examine suicidal capability also with other pain measures. Especially, since Witte et al. (2012) have noted that pressure pain may be a more suitable indicator of capability for suicide given that the most common methods of suicide (e.g. jumping from a height, hanging etc.) involve mechanical pain rather than thermal pain. Fifth, only a single facet of impulsivity – namely, risk taking behavior – was assessed in the current study. It would have been useful to include additional measures of impulsivity, especially those assessing aspects of impulsivity known to be more closely associated with suicide (e.g. negative urgency; Anestis and Joiner, 2011). Sixth, the rather small sample size of the current study resulted in low power to detect medium sized effects ($1-\beta=0.42$). Therefore, non-significant group differences in our study should be interpreted with caution. Nonetheless, a sample size of at least 20 subjects per cell is considered adequate to reduce the risk of false-positive results (Simmons et al., 2011). Finally, though we expanded our effort on *thoroughly* matching the two games used in this study, there may well be distinctions relevant to pain-tolerance and risk-taking behavior. Therefore, future studies should scrutinize whether the games differ in difficulty, fun and frustration. Furthermore, actual game performance should be measured to determine the extent to which game instructions were followed on the driving game compared to the action-shooter game. In order not to overestimate the potential dangers associated with action-shooter gaming (cf. Ferguson et al., 2009), all of these validity issues need to be considered and resolved in future studies.

Summarized, the current study showed that engaging in a first-person action-shooter game for 20 min has considerable impact on pain tolerance and risk-taking behavior – factors relevant to acquiring capability for suicide. Correspondingly, playing violent video games over an extended time period might not only affect aggressive behaviors as previous studies have shown, but might also promote suicidal behavior and therefore contribute to one of the most challenging mental health problems.

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